CORAOPOLIS BRIDCE
Spanning the Ohio River Back Channel at
Ferree Street and Crand Avenue
Coraopolis
Allegheny County
Pennsylvania

HAER No. PA-217

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERINC RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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HISTORIC AMERICAN ENGINEERING RECORD

CORAOPOLIS BRIDGE HAER NO. PA-217

Location: Crossing Ohio River Back Channel on Ferree Street and Grand Avenue, between Coraopolis Borough and Neville Island, Allegheny County, Pennsylvania

UTM: 18.571820.4485180
Quad: Ambridge, Pennsylvania

Date of Construction: Originally constructed 1892; moved to present location 1927

Engineer: Theodore Cooper

Fabricator: Union Bridge Company (through trusses)

Present Owner: Allegheny County
Department of Engineering and Construction
501 County Office Building
Forbes Avenue and Ross Street
Pittsburgh, Pennsylvania 15219

Present Use: Vehicular and pedestrian bridge

Significance: The Coraopolis Bridge comprises two Pennsylvania through truss spans designed by Theodore Cooper and constructed in 1892 across the Allegheny River in Pittsburgh; in 1927, in an innovative demonstration of the adaptability of truss bridges, these spans were floated down river a distance of twelve miles and re-erected in combination with two pony truss spans. The bridge was listed on the National Register of Historic Places on January 7, 1986.

Project Information: This documentation was undertaken from January 1989 through January 1990 by Allegheny County and the Pennsylvania Department of Transportation as a mitigation measure prior to removal of the bridge.

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The Coraopolis Bridge comprises two Pennsylvania truss spans and two pony truss spans, crossing the Back Channel of the Ohio River and the Pennsylvania and Lake Erie Railroad tracks between the Borough of Coraopolis and Neville Island in Allegheny County, Pennsylvania. It achieved its present form in 1927, when its two through truss spans were moved from the crossing of the Allegheny River between Sixth Street in Pittsburgh and Federal Street in Allegheny City, where they had been built in 1892. The Pennsylvania trusses were re-erected on the present site in combination with two pony truss approach spans. The bridge links Ferree Street in Coraopolis with Grand Avenue on Neville Island. It is the second bridge at this crossing; the previous structure, constructed in 1893 to carry a trolley line, was situated on a slight skew from the present bridge alignment. It consisted of three 224' camelback truss spans and five truss and girder spans, varying from 49' to 82' long. The original bridge was not removed until after the relocated structure was opened to traffic.

The bridge presently carries two lanes of vehicular traffic and one pedestrian walkway. At its former location it carried three lanes including a streetcar lane. The structure is a multiple span metal truss bridge comprising two through trusses and two pony trusses, supported by concrete substructure. The spans at the south (Coraopolis) end of the bridge are pony trusses, while the main spans over the river consist of the two relocated through trusses. The overall length of the bridge is approximately 1,163 feet between abutments.

The main Ohio River Back Channel crossing consists of two simply-supported, Pennsylvania trusses (Span Nos. 3 and 4) each measuring approximately 439'. The truss members are typical of late nineteenth century construction, comprising paired eyebars and riveted sections which consist of angles, plates, channels and lacing bars. Members are pin-connected at the joints. The truss portals are ornamented with simple decorative ironwork. At the portals, there is a 20' vertical clearance. The floor system comprises built-up riveted steel floor beams and stringers which support a deck consisting of steel plates, a reinforced concrete deck, and a latex wearing surface.

The south approach spans (Span Nos. 1 and 2) are 132'-8½" pony trusses spanning the Pennsylvania and Lake Erie Railroad. The bridge design included these two new trusses to adapt the main spans to their new location upon their relocation from Sixth Street in Pittsburgh. The pony truss members consist of riveted steel sections with riveted joints, typical of twentieth century truss construction. The floor system comprises built-up riveted steel plates, a reinforced concrete deck, and a latex wearing surface.

The Coraopolis Bridge substructure is reinforced concrete and consists of two abutments, two land piers and one river pier. The north abutment comprises concrete walls supported on concrete caissons, while the south abutment is of concrete construction supported on a concrete spread footing foundation. Piers No. 1 and 2 are solid concrete to approximately fifteen feet below the ground line and are supported by two concrete caissons. Pier No. 3 is solid concrete on a rock foundation.

The roadway is 33' wide between curbs and accommodates two 12' traffic lanes and two 4'-6" shoulders, and there is a sidewalk along the upstream side of the bridge. Ornamental steel hand railing is located along the outside edge of the sidewalk, and a 4-½"-diameter aluminum bridge railing is provided along the top of the downstream (west) traffic barrier.

The Coraopolis Bridge was listed on the National Register of Historic Places on January 7, 1986. The bridge derives historic significance from its age, its unique history at two different sites, and from its association with a nationally significant engineer, Theodore Cooper. Constructed in 1892, the through truss spans reflect an early large-scale application of steel in the fabrication of heavy truss bridges. The 1927 relocation provides an excellent case study in the versatility of the metal truss bridge, exemplifying the adaptability of this structure type, a feature which was highly touted by advocates of this design in the last quarter of the nineteenth century. The through truss bridge has been identified as the only surviving structure entirely designed by Theodore Cooper (1839-1919), who achieved a national reputation for railroad and highway bridge design.

The through truss spans incorporated in the present Coraopolis Bridge were originally erected across the Allegheny River at Sixth Street in Pittsburgh, linking Pittsburgh with the main business thoroughfare of neighboring Allegheny City. This was the third of four bridges to serve that location, which is considered among Pittsburgh's most important river crossings. The growth of Pittsburgh was strongly influenced by its numerous waterways, and the successful linking of the city with its neighboring communities by means of bridges was a significant factor in the development of its metropolitan identity. Allegheny City was annexed by Pittsburgh in 1907, becoming the city's "North Side".

The first bridge to cross the Allegheny at Sixth Street was a six span, flat roofed, covered wooden bridge constructed in 1819. This bridge had a total length of 1,037 feet, consisting of four 185 foot spans, a 170 foot span, and a 137 foot span. The design and construction of this bridge have traditionally been attributed to a Mr. Lothrop; it was presumably a Burr arch truss, like the Ninth (Hand) Street Bridge, another of Lothrop's products. Physical evidence for this assumption survived until the

1890s, when an observer reported that the skewbacks from the wooden arches remained visible in the north abutment.

In 1860 a wire-suspension bridge, designed by John A. Roebling, replaced the decaying timber structure. This bridge was four spans long, with two 344-foot main spans, and approach spans measuring 177 and 171 feet each. The bridge was dominated by cast iron towers, each formed by four cast iron columns.

Although the Roebling bridge, with its iron superstructure, was generally believed non-flammable, it fell victim to fire on June 19, 1881. The bridge was not destroyed, but its floor system of white pine and white oak was severely damaged. John Harper, president of the Allegheny Bridge Company, which owned and operated the structure, stated that he believed the fire was the result of "sparks and perhaps flame from the stacks" of passing steamboats igniting bird nests located under the superstructure of the bridge. After heavy electric streetcars were introduced to the bridge in 1890, concern over its functional capacity grew, and in 1891 plans were begun to replace the suspension bridge with one that could better handle the steadily increasing traffic, as well as permit trolleys to cross without reducing their speed.

The third Sixth Street Bridge was designed by the nationally-significant engineer Theodore Cooper (1839-1919). Upon receiving a degree in civil engineering in 1858, Cooper accepted a position as Assistant Engineer on the Troy and Greenfield Railroad and Hoosac (Massachusetts) Tunnel. He entered the Navy in 1861; his military career lasted over a decade and included active duty aboard the gunboat Chocorua and the Nyack in the South Pacific, as well as assignments as an instructor and engineer at the Naval Academy. After resigning from the Navy in 1872 with the rank of First Assistant Engineer, he was appointed inspector at the Midvale Steel Works by James Eads, designer of the noteworthy Mississippi River steel arch bridge at St. Louis; he succeeded Eads as Engineer of the Bridge and Tunnel Company from 1872-75.

Cooper's designs included a broad variety of structures, ranging from the Laredo Shops of the Mexican National Railroad to the furnace plant of the Lackawanna Coal and Iron Company at Scranton, Pennsylvania, but his most memorable contributions were in the area of bridge design. His bridge-building career extended from his discharge from the Navy in 1872 until his retirement in 1907. He designed the Junction Bridges over the Allegheny River at Pittsburgh (1876), the Seekonk Bridge at Providence, Rhode Island, the Second Avenue Bridge over the Harlem River at New York City, and the Newburyport (Massachusetts) Bridge over the Merrimac River. The third Sixth Street Bridge has been identified as the only surviving structure entirely designed by Cooper, whose involvement extended even to such details as the bridge's handrail, lamps, and fascia.

During the period between 1885 and 1902, Cooper published several important works on railroad and highway bridge design. His theories strongly influenced the adoption of wheel-load analysis for railroad bridges. Also during this period he served as consultant to numerous commissions charged with the development of rapid transit systems in such cities as New York and Boston. The career of this distinguished and celebrated engineer (twice awarded the Norman Medal by the American Society of Civil Engineers) ended in tragedy when the monumental Quebec Bridge, for which Cooper was supervising engineer, collapsed while under construction in 1907 with 82 casualties.

The third Sixth Street Bridge, like most roadway river bridges in the nineteenth century, was privately built and operated as a toll crossing. The total cost of construction was $560,000. This cost was underwritten by the Sixth Street Bridge Company and Fidelity Title and Trust Company, successors to the Allegheny Bridge Company, which had received its charter in 1810. When the bridge was opened in 1893, the toll was set at two cents for each man, while women crossed at no charge. Beginning in the late 1890s, Allegheny County and the City of Pittsburgh undertook a systematic program of acquiring the privately-owned bridges within their jurisdiction and eliminating their tolls. The Sixth Street Bridge was purchased by Allegheny County in 1911 along with nine other bridges at the combined price of $2,851,000; all ten of these bridges were subsequently declared free.

The trusses for the third Sixth Street Bridge were fabricated by the Union Bridge Company. This company had been formed in 1884 by the merging of the Central Bridge Company of Buffalo, New York, and Kellogg and Maurice of Athens, Pennsylvania. The Buffalo plant was closed around 1890, so presumably the trusses were produced in the shops which remained at Athens.

The superstructure was erected by the Baird Brothers, John and William, who first advertised in the Pittsburgh and Allegheny City Directory in 1886 as contractors located at Home and Valley Streets. In the 1891 and 1892 editions of the Directory they were listed as bridge builders; their listings no longer appeared by 1900, and by 1911 William Baird had left the construction business and had begun managing a hotel.

The Baird Brothers had been involved with numerous bridge projects and companies in the late nineteenth century. William Baird had worked on seven bridges crossing the Missouri River, the Merchants Bridge across the Mississippi River at St. Louis, two bridges crossing the Ohio River at Wheeling, the bridge carrying the Baltimore & Ohio Railroad across the Susquehanna River, and bridges at Steubenville, Ohio, and Poughkeepsie, New York. John Baird had been involved in the construction of the Eads Bridge in St. Louis and the Cairo bridge in Memphis, and had been employed by the McCann Construction Company, the Keystone Bridge Company and

American Bridge Company.

The masonry substructure, which included an approach span at the Pittsburgh end 105 feet long, pierced with two 28-foot semicircular arch openings, two new piers, and the addition of a new coping course to the anchorage masonry of the old suspension bridge at the Allegheny end, was constructed by the Drake and Stratton Company, Limited, of Pittsburgh. This firm advertised in the Pittsburgh and Allegheny City Directory from 1886 to 1912; they were listed as contractors, and during most of this period gave their location as 111 Fourth Avenue. J. Wainwright, a Vice President of the Company, supervised the work on this project. Drake and Stratton also probably erected the four Neoclassical toll booths of Pompeian brick, two of which stood at either portal.

The decorative elements designed by Theodore Cooper were produced by the Jackson Architectural Iron Works of New York. The roadway was paved by George L. Peabody of Pittsburgh. William Glyde Wilkins and George S. Davidson of the firm of Wilkins and Davidson served as Resident Engineers for the project, which Wilkins documented in a paper presented to the Engineers' Society of Western Pennsylvania on May 16, 1895.

The importance of the Sixth Street crossing to the traffic pattern between Pittsburgh and Allegheny City dictated that the new bridge be constructed in such a manner as to interfere as little as possible with streetcar and pedestrian transit. This was accomplished by constructing the new bridge virtually around the existing structure. As described in the account presented by Resident Engineer W. G. Wilkins, the process took 95 days, required careful measures to protect the old and new substructures, and was "safely accomplished virtually without interruption of streetcar and foot traffic."

Indeed, streetcar travel was actually facilitated during the construction of the bridge, as wagon traffic had been temporarily suspended, eliminating the delays for trolley passengers which occurred when a slow team crossed ahead of the car. As the construction took place during a period of low river stage, during which there was very little steamboat traffic, river travel was not unduly disrupted, despite the fact that the equipment required for the bridge's erection had left only a narrow opening for vessels to negotiate.

The third Sixth Street bridge effectively relieved the functional inadequacies of its predecessor with regard to vehicular and pedestrian crossing; Wilkins extolled it as "simply an extension of the streets over the river, and no more restrictions are placed on traffic than on the streets."

Within a decade, however, increasing traffic on the waterway under the bridge brought about calls for its removal as an obstruction to navigation. The limited clearance of the channel spans of the seven bridges over the Allegheny River from Sixth Street up to Forty-Third Street effectively restricted the height of boats traveling the river, so that fluctuations in river stage rendered the Allegheny impassable to stern-wheeled craft for unpredictable and sometimes long periods. This was considered a hindrance to the growth of commerce and industry by the Rivers and Harbors Committee of the Pittsburgh Chamber of Commerce, and was also a matter of concern to the Federal Department of War, which was charged with maintaining unobstructed river travel for defensive purposes. Although the design of the Sixth Street Bridge had been approved by both the War Department and the influential Pittsburgh Coal Exchange, representing the commercial interests, prior to its construction in 1892, by the turn of the century the increase in river commerce brought the issue to a head once again.

While the Pittsburgh City Council and the Municipal Affairs Committee of the Chamber of Commerce argued for the retention of the existing bridges, the issue was ultimately decided by the Department of War, acting under the authority of Section 18 of the Rivers and Harbors Act of March 3, 1890 (30 Stat., 1121-1153). This act empowered the Secretary of War to require the removal or alteration of any bridge which " . . . is an unreasonable obstruction to the free navigation . . . on account of insufficient height, width of span, or otherwise."

The matter of the Allegheny River bridges was reviewed over a period of fourteen years by six different Secretaries of War. In 1903, district engineer William L. Sibert held hearings on the issue, and referred it to Secretary of War Elihu Root, recommending that the Secretary determine the bridges obstructive. Secretary Root did not concur, however; in a decision of January 23, 1904, the Secretary found that the bridges "could not at that time be regarded as unreasonably obstructive." Five years later, in 1909, a board of engineer officers headed by Brigadier General W. H. Bixby was appointed by then-Secretary of War Luke E. Wright to reconsider the question. The board, known as the Bixby Board, found that these bridges " . . . as they now exist, are unreasonable obstructions to navigation and such as to hinder the growth of river commerce." The Bixby Board's finding, however, was disregarded by Secretary J. M. Dickinson in 1911. Not until 1917 would a Secretary of War rule in favor of removing the bridges through Federal intervention.

In 1917 the Secretary of War, Newton D. Baker, found the bridges' headroom and clearance width to be a deterrent to navigation and commerce on the Allegheny River, and a hindrance to the economic and industrial growth, of the area. In an opinion issued March 23, 1917, Secretary Baker observed that the Pittsburgh area had

profound economic importance to the country as a whole, and that facilitating its industrial development was in the broad national interest: " . . . It is the undisputed center of the steel industry of the country, and its industrial importance to the Nation can hardly be overestimated. Its continued growth and development, the multiplication of its facilities, and the introduction of all available aids to the great industrial enterprises carried on there are matters of the highest importance, alike to the people of the Nation and to the Nation itself."

Secretary Baker had inspected the situation personally, and found that the bridges presented obstacles to navigation not only in their height above the water, but also by their piers which were staggered throughout the channel and hazardous to maneuver around, especially under flood conditions.

In ordering the "immediate elevation and . . . relocation of [the] piers" of the Allegheny River bridges as "necessary in the national interest," Secretary Baker acted in response to "a confident feeling that the future of the city of Pittsburgh is of tremendous importance to the Nation, that by the order which I am now making I am freeing a great natural highway to contribute to the further expansion and growth of the city, and freeing the Allegheny River from obstructions which have until now prevented its being used, as a valuable part of the harbor of the city and a valuable artery of trade."

The Secretary's requirements for the new construction included such details as a clear width of at least 400 feet between piers and "that the south end of the channel span be located about 416 feet distant from the building line of Duquesne Way at Federal Street." This span had to have a clearance height of at least 47 feet above the Davis Island pool.

Although Secretary Baker signed the order which called for the elevation of the spans and relocation of the piers of Pittsburgh's Allegheny River bridges in 1917, almost ten years passed until the Sixth Street Bridge was replaced. The original order of 1917 stated that the alterations to the bridge had to begin within two and a half years and be completed in no greater time than four and a half years. Work to implement this order was suspended with involvement of the country in World War I. The order was re-issued on the same terms on March 31, 1919; in the interim, one bridge had been raised, another was in process of reconstruction, and a third had been destroyed by fire.

An alternative plan was proposed by A. A. Henderson of Wilkinsburg, Pennsylvania in 1919. He suggested that the replacement bridges across the Allegheny be equipped with liftable spans, to enable them to accommodate clearance

requirements at varying river stages, rather than fixed-height spans whose elevation would be dictated by the maximum stage. This would reduce the effect of the steep approach grades necessitated by high spans. This suggestion, reported in the Engineering News-Record for October 9, 1919, was not incorporated into the design of the replacement structures.

The removal of the Sixth Street Bridge did not occur until 1927. It was one of the last of the designated bridges to come down, and unlike its neighboring bridges at Seventh and Eighth Streets, it was determined to be suitable for reuse. At the close of the first World War, a new Board of Commissioners was elected in Allegheny County, and took as its charge the resumption of the county's public improvement program, which had been curtailed by the war effort. In 1924, the County Commissioners issued over $29 million in bonds to finance a four-year program of bridge and highway construction, and established the Allegheny County Board of Public Works to oversee its implementation. The new Board comprised three Bureaus: Bridges, Highways, and Tests and Materials. Under the direction of Chief Engineer Vernon R. Covell, the Bureau of Bridges was responsible for numerous projects which have come to be regarded as highly innovative and of uniformly high quality. By means of the imaginative strategy of relocating the massive spans, the Bureau of Bridges was able to effect a new crossing of the back channel of the Ohio River between the borough of Coraopolis and Neville Island, while saving County taxpayers some $300,000 compared to the cost of new construction.

Increasing industrial development had prompted interest in a new bridge linking those two Ohio River communities. Originally settled in 1759, the region around present Coraopolis developed slowly for over a century. The area remained sparsely populated, and most of the inhabitants were engaged in agriculture. A few local industries emerged in the early nineteenth century, including a tannery, sawmill, brickyard and a boatbuilding enterprise. A Methodist Episcopal Church was built in the community in 1849; in 1861 a post office was established, called Vance Fort to recall the stockade erected by the original settler, Robert Vance, and a one-room school was in operation by 1873. The population of the area had reached 140 in 1880.

The completion of the Pittsburgh & Lake Erie Railroad in 1879 began the transformation of Vance Fort from a rural outpost to a center of river and rail commerce. Land speculators laid out lots, anticipating the growth of an industrial metropolis; the borough was incorporated in 1886 and the name changed from Middletown, which had replaced Vance Fort, to Coraopolis. A committee was established to promote the borough as a site for industries to relocate, and the first enterprise, a slitting and slotting mill, opened in 1887.

Development did not proceed quite as rapidly as local boosters may have hoped, but nevertheless the population had swelled nearly sevenfold to 974 by the turn of the decade. Part of this increase was attributable to transients, however. The discovery of oil in marketable quantities at both ends of the town in 1890 brought in a gusher of laborers.

During the early phases of the growth of Coraopolis, the 1000-acres of Neville Island remained devoted to agriculture. The island's fertile soil enabled its farmers to be counted among the most successful in the Ohio Valley, with standing orders from the prestigious hotels of Pittsburgh. So important was Neville Island produce to the city that the island became known as the "Market Basket of Pittsburgh."

To stimulate economic development in the region, a group of investors from Coraopolis conceived the idea of constructing a high-speed electric railway over Neville Island, at first to carry garden produce but shortly to transport passengers and commuters to and from the factories that were envisioned springing up along the route. The Pittsburgh, Neville Island, and Coraopolis Railway Company was organized in 1892 and began acquiring rights-of-way for the ambitious project, which entailed the construction of a nine-mile highway the length of Neville Island and the erection of a bridge from Ferree Street in Coraopolis to the island. Construction began the following year and was completed in 1894, at a total cost of $240,000. This achievement was claimed as "the first high speed railway in the United States" in a local publication commemorating the semi-centennial of the Borough of Coraopolis. The bridge consisted of three Pennsylvania trusses, each measuring approximately 224 feet long and crossing the Back Channel of the Ohio River. On the Coraopolis end, four small pony trusses and two plate girders spanned the railroad tracks from Ferree Street to the first through truss span. The 1894 bridge was removed in 1927 when the current Coraopolis Bridge was constructed.

The establishment of the electric railway caused an immediate influx of industry to the area. The first enterprise to relocate to Coraopolis was the Consolidated Lamp & Glass Company, which moved its operations from Fostoria, Ohio, in 1894. The Canfield Oil Company arrived the following year, and by the end of the decade the Montour Railroad Shops and the Duquesne Steel Foundry had also located in Coraopolis. Encouraged by this upsurge in industrial development, the Borough undertook an extensive program of public improvements in the late 1890s, including the construction of an electrio power plant in 1897 and a municipal water plant in 1898.

As Coraopolis grew, industrialists began to develop plans for Neville Island as well. A 1900 article in the Pittsburgh Dispatch observed that the island's renown for garden produce had extended "until but two short seasons past," but at the time of

writing, farms were already being relinquished to industry, and "it is evident that in the not far distant future the entire island will be covered with manufacturing establishments and dwellings."

The first decade of the twentieth century saw the establishment of the Lewis Foundry and Machine Company (1900) and Graham Bolt and Nut Company (1904) at Coraopolis, and the first plant of the Dravo Corporation on Neville Island (1906). Industrial development continued at a steady pace in Coraopolis during the following decade, with the operations of the Carbo-Oxygen Company and Standard Steel Spring Company both opening in 1914, and the Pittsburgh Forgings Corporation locating its plant there in 1919. The Concrete Products Company of America began work at Neville Island in 1913, and was joined in 1916 by the Pittsburgh/Des Moines Steel Company and the Independent Bridge Company.

The future of Neville Island was profoundly affected by the federal government's plans to construct a huge munitions plant there during World War I. Until that time, farmers had managed to maintain a foothold on the island despite increasing encroachment by industrial interests. At least one privately-financed scheme to acquire the entire island for industrial development had failed. While the electric railway was under construction in the early 1890s, J. W. Arras, president of the railway company, secured the backing of Philadelphia capitalists to purchase the island for resale to manufacturing concerns, but the plan was defeated after a local newspaper disclosed it. In 1918, however, the federal government exercised its powers of eminent domain and purchased the land from the farmers for $8,700,000. The government then began construction of what was intended to be the world's largest munitions factory, but abandoned the project when the Armistice obviated the need for it. In December 1921, the land was sold at auction, and industrialists easily outbid the displaced farmers. Thus the die was cast and the future character of land use on Neville Island determined; heavy industry surged in, eventually occupying 80 percent of the island's total area.

The 1920s witnessed an oil boom in the Ohio Valley, which became important to Coraopolis in the latter part of the decade. The Republic, Robinson, and Vulcan were among the several oil companies which operated at Coraopolis in the late 1920s. In addition to these enterprises, the Neville Company began producing coal tar products on Neville Island in 1927, and Gulf Oil Corporation located on the island in 1931.

With the increasing industrial growth of Coraopolis and Neville Island came a commensurate need for improved transit between the two communities. The bridge which had been constructed in 1893 to carry the electric railway was no longer adequate to transport the numerous commuters and commodities which had to pass

across the river daily. The population of Coraopolis had seen its greatest increase between 1890 and 1900, when it rose from 974 to 2555; it doubled again, to 5252, by 1910, and reached 10,715 in 1930, at which time local historian Edward B. Maurey observed that many of the residents were employed at factories in the area, including those on Neville Island. The requirement for improved facilities to convey these workers had become clear by the late 1920s.

The plan for the new Coraopolis bridge thus began. The supervising engineers for the innovative relocation of the Sixth Street Bridge were associated with the Foundation Company of New York, which had established an international reputation for the construction of pneumatic caissons for building foundations and bridge piers. The company essentially controlled this specialty within the construction industry in the early twentieth century, when skyscrapers were radically altering the skyline of New York City; the Foundation Company sank the caissons for many of the tall buildings constructed in Manhattan during this period, including the Empire State Building. In addition, it had been involved in the construction of numerous bridges, including those which carried the Canadian Pacific Railway across the nation; the Foundation Company had established a subsidiary in Canada in 1910 to supervise the railroad job, and its Canadian operations became so important that this subsidiary acquired a half-interest in the New York firm in 1924 and took over the company entirely in 1929. The Foundation Company was involved in every aspect of the relocation of the Sixth Street Bridge. They devised and carried out the procedure for dismantling and transporting the spans, constructed the north abutment at Coraopolis and Piers 2 and 3, and re-erected the bridge at its new site.

The relocation of the Sixth Street Bridge commenced January 1, 1927, when it was closed to traffic and the first steps were taken for its removal from the site. The sidewalks were taken off, the deck stripped of its concrete pavement, and shore connections were disengaged. The two 440-foot spans were handled separately, with the south span first. The entire procedure of dismantling, moving, and re-erecting the bridge took 140 days.

The technical significance of this accomplishment was sufficiently great to warrant extensive coverage in the engineering press. The Engineering News-Record devoted two illustrated articles to the project; Foundation Company engineer D. T. Jerman was the author, and described the relocation process in considerable detail:

> To lower the spans to the scows on which they [were] to be floated, the contractor designed a steel tower capable of carrying the ends of both spans at the center pier, and a similar tower for the south end of the south span, the latter to be subsequently moved to the north

> end of the north span. The towers were erected by cutting recesses in the stone masonry and transferring the load from the shoes to the tower. . . . After the load had been transferred to the steel tower the masonry was removed and the bridge was ready for lowering. Each shoe was supported on four tension plates or steel straps, 18x1 in., 47 ft. long, punched with 26 holes 7 in. in diameter and 15 in. from center to center; the spacing of holes was made to correspond with the runout of the jacks.

Joseph White and M. W. von Bernewitz in their 1928 work The Bridges of Pittsburgh further elaborated the procedure:

> [The straps] did not work singly but were paired so as to function like a sling or a loop. At the upper end of each loop was inserted a steel forged movable pin 38 inches long. The steel pin rested upon the plunger of a jack, which in turn rested on the steel tower. Eight 500-ton jacks, one for each loop, were used. Throughout the operation the jacks remained at the same elevation; as the bridge was lowered the length of the loop was lengthened 15 inches by shifting the movable pin to the set of holes above, and so on until lowered the full distance. . . . At a given signal, . . . the four plungers [of the jacks] gradually lowered and when they had moved downward their full distance, one end of the bridge had been lowered 15 inches. At another signal, the four jacks at the other end of the bridge were bled, then that end of the bridge was lowered 15 inches; thus the bridge was titled down end by end in steps of 15 inches for the complete distance of 18 feet. The total actual lowering period was 14 hours.

Jerman's account described the preparation of the barges which carried the span:

> The span was lowered onto four steel barges, each of 1,000 tons capacity, fastened together in pairs and placed longitudinally with the span. Blocking was placed on the steel girders that fastened the barges together, at each panel point of the span, so that the span [was] resting at 42 points. . . . After the span was loaded on barges, which took one day, it was moved endwise so that the shoes cleared the center pier tower, and then swung downstream, where steamboats took hold of it and towed it to the north shore of the Allegheny River above Manchester bridge.

To reach its destination at Coraopolis the convoy had to clear both the Manchester Bridge, over the Allegheny, and the Ohio Connecting Railroad bridge, over the Ohio River, at Brunot Island, as well as proceed through the locks at Emsworth Dam. In order to pass under the two bridges an additional 27 feet of clearance was required. Two methods of achieving this were considered: removing the top chord of the structure, or partially submerging the barges at each bridge. The former method was chosen, as it appeared to be both safer and less expensive than the latter. Removal of part of the top chord compromised the structural stability of the truss, however, and special supports had to be provided on the barges to counteract this effect:

> This disconnection of part of the top chord is another reason why it was necessary to support the bridge under each floor beam. The Sixth Street Bridge is a bow-top truss; the string of the bow is made up of 16 eye-bar panels pinned together. As long as the bow is kept intact the structure is rigid, and could be moved by supporting it at its two ends, if necessary, but if the bow of the arch were cut the entire structure becomes unstabilized and requires support at every panel point throughout its length.

Jerman described the process of removing the top chord in another Engineering News-Record article:

> In order to relieve the stresses in the truss members, the barges were jacked down, beginning at the center of the span and following up each panel point to either end. Much heavier jacking was necessary than was anticipated as the joints were very stiff. . . . As the top chord of the span reached a height of 100 ft. above the water and there was no floating equipment available to reach this distance, a special traveler was designed to dismantle the top chord. For this purpose a timber runway was built along the upper tier of cross struts and on this a wooden traveler was erected with steel outriggers to reach outside the trusses on either side. The top chord sections, each weighing about 10 tons, were lifted vertically out of position and then moved horizontally outside the truss and lowered to the floor of the span. After the top chord was dismantled, the diagonals were laid down and lashed to the uprights. The vertical posts were disconnected at the nearest panel points and traveler and runway were dismantled and laid on the floor span.

The barge carrying the span was then towed by two steamboats for five hours until it reached its destination near Neville Island twelve miles away. Jerman described the re-erection:

> At the lower end of Neville Island the dismantled top chords were re-assembled and the barges were towed some distance below the end of the Island to prevent possible grounding; then they were backed up the channel to the site of the present bridge. The operation at Coraopolis was just the reverse from that at Pittsburgh, but instead of lowering the bridge 18 feet it was necessary to raise it 32 feet. The same steel towers that were used at Pittsburgh were used at Coraopolis; and the bridge was elevated to its final position by the same straps and by the same jacks. The cost of moving the bridge was $316,000; the entire operation was accomplished in 140 days.

The Farris Engineering Company, a Pittsburgh company located in the Empire Building, performed a great deal of work on the bridge at its new location. The original approved contract for their work had a price total of $271,811.50. They built portions of the substructure that the Foundation Company had not done. Farris also erected the two pony truss approach spans, repaired and painted the main superstructure, and paved the bridge deck and the two approaches.

The approach spans, and the end bearings for the main spans, were fabricated by the American Bridge Company at its shops located in Ambridge, Pennsylvania. The company maintained an office in the Frick Building in Pittsburgh.

The Delmer Electric Company of Pittsburgh was paid $6,378 for lighting conduits, navigation lanterns, a meter switch box, and other electrical work on the bridge at its Coraopolis location.

The total cost of the relocation and re-erection of the Sixth Street Bridge at Coraopolis was estimated at $800,000.

The bridge was opened to streetcar and one-way traffic on October 5. At the end of the month, on the 31st, the official ribbon-cutting ceremony was held, which included a parade of almost 500 cars, a "half holiday" and a Halloween celebration. The old electric railway bridge was subsequently demolished.

Allegheny County will replace the Coraopolis Bridge with a new bridge at this location. Due to its deteriorated condition and inadequate load carrying capacity, the existing four span truss bridge does not meet the transportation needs of its location.

It is currently restricted to carrying vehicles with a maximum weight of three tons, and it is only open to vehicular traffic during periods when the temperature is above 30 degrees Fahrenheit.

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